(12) UK Patent Application (19) GB (11) 2 207 335 (13) A

(43) Application published 1 Feb 1989

(21) Application No 8818149

(22) Date of filing 29 Jul 1988

(30) Priority data
(31) 80519 (32) 31 Jul 1987 (33) US

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(51) INT CL⁴
A23L 2/00

(52) Domestic classification (Edition J):
A2B MH19

(56) Documents cited
GB A 2162849 GB A 2095530

(58) Field of search
A2B
Selected US specifications from IPC sub-classes
A23C A23L

(54) Calcium-supplemented beverages and beverage concentrates containing low levels of chloride

(57) Beverage and beverage concentrates nutritionally supplemented with significant levels of solubilized calcium and containing low levels of chloride are disclosed. These beverages and concentrates also contain specified levels of edible organic acids selected from citric acid, malic acid, fumaric acid, adipic acid, gluconic acid, tartaric acid, and lactic acid, as well as mixtures of these acids. Other components are fruit and /or botanical flavors and sweetener. The weight ratio of total acids and chloride combined to solubilized calcium, as well as the particular acid mixtures, are selected to provide the desired flavor and sourness character for the beverages and concentrates. Inclusion of low levels of chloride in these beverages and concentrates provides a quicker onset of sourness and improves the solubility of the calcium, particularly when high levels of citric or phosphoric acid are used.

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CALCIUM-SUPPLEMENTED BEVERAGES AND BEVERAGE CONCENTRATES CONTAINING LOW LEVELS OF CHLORIDE

TECHNICAL FIELD

This application relates to beverages and beverage concentrates for preparing same which are nutritionally supplemented with significant levels of calcium. This application particularly relates to calcium-supplemented beverages and beverage concentrates which contain low levels of chloride.

Dietary calcium inadequacy may be a contributing cause to osteoporosis, at least for some populations. For example, a positive correlation between calcium intake and bone mass has been found across many age groups. It has also been suggested that the level of calcium intake early in life directly influences the peak bone mass achieved at skeletal maturity.

During the period of late teenage to young adulthood, it has been found that a significant reduction in dietary calcium intake typically occurs. This is especially true of the female population where reduced dietary calcium intake usually happens much earlier in life compared to their male counterparts. Accordingly, females, as a class, are especially susceptible to a prolonged calcium deficit over their life span. This calcium deficit may be one reason for the greater incidence of osteoporosis in postmenopausal women.

Calcium can be obtained from a variety of dietary sources. The primary sources of calcium are dairy products, in particular milk. Milk provides a very valuable source of dietary calcium. However, beginning in young adulthood and continuing through later life, milk is typically not consumed in sufficient quantities by the general population to obtain needed levels of calcium. This may be caused by the unattractiveness of milk as a drink for "social occasions". Indeed, it has been found that teenage girls, and especially young adult women, generally find milk to be a

socially unattractive drink, as well as too caloric and unappealing in taste.

To achieve greater consumption of calcium, a more appealing alternative to milk is apparently needed. This alternative must be one which is consumed in sufficient quantities to provide nutritionally beneficial amounts of calcium. Products which are consumed in great quantities by teenagers and young adults are carbonated soft drinks. Unlike milk, soft drinks can be formulated with a variety of flavors generated by natural flavor oils, flavor extracts and synthetically derived flavor materials. The numerous flavor impressions possible may be the reason why soft drinks are very attractive to this particular group. Accordingly, soft drinks nutritionally supplemented with calcium could be viewed as a potential vehicle for achieving greater dietary calcium intake during this critical teenage/young adult period, and throughout life as well.

Nutritional supplementation of soft drinks, or other non-milk beverages, with significant levels of calcium is not straight forward. Milk contains, on average, about 0.12% calcium by weight. Inclusion of such a high level of calcium in a soft drink requires consideration of a number of issues.

One is making sure that the calcium supplemented drink has desirable taste and mouthfeel qualities. It has been found that high levels of calcium can impart significant "chalky" mouthfeel sensations to a soft drink. This has been found to be especially true for soft drinks based on high levels of citric acid as the acidulant. In addition, it has been found that high levels of calcium can cause undesirable "biting/burning" mouthfeel sensations long after the soft drink is consumed. This "aftertaste" problem is especially true of soft drinks based on high levels of phosphoric acid as the acidulant.

Another factor which must be considered is the sourness impression of the soft drink. Calcium-containing soft drinks based on high levels of edible acids such as citric acid or phosphoric acid typically have a slower, more lingering onset of sourness.

This is due to the ability of these acids to buffer the soft drink to a relatively high, though acidic pH. A quicker onset of sourness is usually desirable for certain soft drinks, in particular those having a cola-type flavor.

Another potential issue is precipitation of insoluble calcium salts such as calcium citrate and calcium phosphate. Stability against precipitation is a very significant problem for beverage concentrates used to prepare soft drinks because of the very high levels of calcium salts present. However, at even moderate concentrations in drinkable beverages, stability against precipitation of insoluble calcium salts can be important.

BACKGROUND ART

U.S. Patent 3,114,641 to Sperti et al, issued December 17, 1963, discloses extended citrus juice products obtained by diluting single-strength citrus juice or concentrated citrus juice. To maintain the flavor of the diluted product, materials such as calcium chloride, magnesium chloride, sodium or potassium citrates, tartaric and malic acids (or their salts) are included in "very small amounts." One example of an additive formula for use with these extended products contains 0.04% calcium chloride (about 0.015% calcium and about 0.025% chloride), 0.85% citric acid and 0.06% sodium citrate. See column 5, lines 10-20.

U.S. Patent 3,657,424 to Aktins et al, issued April 18, 1972, discloses the fortification of citrus juices with sodium, calcium and chloride ions in amounts beyond what is naturally present in the juice. Calcium salts which can be used in fortification include the chlorides, citrates or phosphates, although calcium chloride is preferred for providing the desired chloride ion. The maximum amounts of calcium salts permitted in these fortified citrus juices is up to about 0.04%. (This calculates to a maximum of about 0.015% calcium in the juice if calcium chloride is used.) These fortified juice products also contain from about 0.019 to 0.18% sodium salt, preferably as sodium chloride.

British Patent Specification 2,095,530 (Nestle), published October 6, 1982, discloses a process for obtaining an acid

beverage enriched in protein, particularly a fruit juice or fruit-flavored beverage. In this process, an aqueous suspension of soy protein is prepared using water and/or fruit juice. Calcium (as the chloride, acetate, tartrate, malate or lactate salt) is added in a concentration of from 5 to 50 mM, after which the pH of the suspension is reduced by addition of acid and the insoluble material separated to yield a protein solution. A fruit or fruit flavoring can then be added to this protein solution. From the Examples, calcium chloride appears to be the preferred calcium salt, while HCl appears to be the preferred acid. The calcium can be "in a proportion which may attain that which is naturally found in cow's milk."

U.S. Patent 4,322,407 to Ko, issued March 30, 1982, discloses an electrolyte drink containing sodium, potassium, magnesium, chloride, sulfate, phosphate, citrate, sucrose, dextrose, ascorbic acid and pyridoxine.

U.S. Patent 4,592,909 to Winer et al, issued June 3, 1986, discloses a water-based drink which consists essentially of purified water, sodium chloride or phosphate, potassium chloride or phosphate, calcium chloride, and magnesium chloride. Preferred compositions comprise from about 0.006 to about 0.010% by weight sodium chloride, from about 0.0045 to about 0.0075% by weight potassium chloride, from about 0.000192 to about 0.000312% by weight magnesium chloride, and from about 0.0375 to about 0.0625% by weight calcium chloride, the balance being purified water.

U.S. Patent 2,297,599 to Wilen, issued September 29, 1942, discloses effervescent tablets consisting of an effervescent core and an outer layer containing a therapeutic active together with an effervescent base. One such effervescent alkalizing tablet contains calcium gluconate, sodium bicarbonate, potassium bicarbonate, magnesium sulfate, sodium chloride and an effervescent base of sodium bicarbonate, citric acid and tartaric acid.

DISCLOSURE OF THE INVENTION

The present invention relates to beverages, and beverage concentrates for preparing same, which are nutritionally

supplemented with significant levels of calcium. The beverages of the present invention comprise:

(a) from 0.05 to 0.15% by weight solubilized calcium;

(b) from 0.15 to 1% by weight of an edible acid component comprising from 0.05 to 1% by weight of an edible organic acid selected from citric acid, malic acid, fumaric acid, adipic acid, gluconic acid, tartaric acid, lactic acid and mixtures thereof;

(c) from 0.02 to 0.05% by weight chloride;

(d) the weight ratio of the acid component and chloride combined to solubilized calcium being from 4 to 7;

(e) a flavor component which contains no more than 20% fruit juice by weight on a single-strength basis; and

(f) an effective amount of a sweetener.

For beverage concentrates of the present invention, the level of solubilized calcium is from 0.15 to 0.75% by weight, the level of the acid component is from 0.45 to 5% by weight, the level of organic acids is from 0.15 to 5% by weight, and the level of chloride is from 0.06 to 0.25% by weight.

The beverages of the present invention supply significant levels of nutritionally beneficial calcium. These beverages also have a quicker onset of sourness, even though edible acid systems such as citric acid or phosphoric acid are used. This is due to inclusion of low levels of chloride which lowers the pH of the beverage due to the reduced buffering capacity of the acid system. Inclusion of chloride also improves the solubility of calcium in these beverages, and especially concentrates for preparing these beverages, even when they contain high levels of citric acid or phosphoric acid.

A. Definitions

As used herein, the term "beverage" refers to a beverage composition which is in a single-strength, ready-to-serve, drinkable form. Beverages of the present invention typically comprise at least 80% (preferably at least 85%) water. Beverages

contemplated within the scope of the present invention include both carbonated and noncarbonated forms.

As used herein, the term "beverage concentrate" refers to a beverage composition in liquid form used to prepare a drinkable beverage. Sugar-sweetened beverage concentrates within the scope of the present invention typically comprise from 30 to 70% (preferably from 40 to 60%) water. These concentrates are usually formulated to provide drinkable beverages when diluted with 2 to 4 parts by weight water.

As used herein, the term "beverage syrup" refers to a beverage concentrate which further comprises sugar. Beverage syrups typically comprise from 30 to 70% by weight sugar.

As used herein, the term "comprising" means various components can be conjointly employed in the beverages and beverage concentrates of the present invention. Accordingly, the term "comprising" encompasses the more restrictive terms "consisting essentially of" and "consisting of".

B. Calcium Levels, Acid Systems, Total Acids and Chloride to Calcium Ratios and Chloride Levels

The key nutritional component of the beverages and beverage concentrates of the present invention is calcium. Suitable sources of calcium include calcium carbonate, calcium chloride, calcium phosphate, calcium hydrogen phosphate and calcium dihydrogen phosphate, calcium hydroxide, as well as the respective sour salts of calcium, e.g., calcium citrate, calcium malate, calcium gluconate or calcium lactate. Mixtures of calcium carbonate and calcium chloride are particularly preferred calcium sources. To be useful in the present invention, the calcium needs to be "solubilized", i.e., dissolved, in the beverage or beverage concentrate. Accordingly, the amount of calcium included in the beverages and beverage concentrates of the present invention will be referred to in terms of "solubilized calcium", i.e., the amount of calcium ion dissolved.

For beverages of the present invention, calcium is present in an amount of at least 0.05% by weight. This minimum level of

calcium (about half of milk level) provides significant nutritional supplementation for the beverage. The maximum level of calcium is up to 0.15% by weight. As the level of calcium in the beverage is increased much beyond 0.15% by weight, satisfactory mouthfeel, taste and stability properties become much more difficult to achieve. Preferably, the level of calcium in such beverages is from 0.055 to 0.09% by weight.

With regard to beverage concentrates used to prepare beverages of the present invention, the amount of calcium present is from 0.15% to 0.75% by weight. Typically, beverages of the present invention are prepared from 3-fold (3X) to 5-fold (5X) beverage concentrates. Accordingly, the level of calcium is preferably in the range of from 0.16 to 0.45% by weight for these concentrates when they are used to prepare beverages having from 0.055 to 0.09% by weight solubilized calcium.

A key component for drinkable beverages and beverage concentrates of the present invention from the standpoint of stability against precipitation of insoluble calcium salts, mouthfeel/aftertaste quality and desirable onset of sourness is the edible acid component. This acid component comprises one or more edible organic acids selected from citric acid, malic acid, fumaric acid, adipic acid, gluconic acid, tartaric acid, lactic acid, or mixtures thereof. These acids can be present in their undissociated form or else as the respective sour salts, i.e. citrate, malate, gluconate, and lactate. Particularly preferred organic acid systems comprise citric acid, malic acid or combinations of citric and malic acid.

If desired, edible inorganic acids can be included as part of the acid component of these beverages and beverage concentrates. A particularly preferred inorganic acid for inclusion as part of the acid component is phosphoric acid, particularly for beverages having a cola-type flavor component. Phosphoric acid can be present in its undissociated form, or else as a respective sour salt, i.e. hydrogen phosphate, dihydrogen phosphate, etc.

For beverages having from 0.05 to 0.15% by weight solubilized calcium, the level of organic acids (added or from juice) can range from 0.05 to 1% by weight. (Because tartaric acid can cause precipitation of calcium, the level of this acid is preferably no more than 0.03% by weight of the beverage.) For beverage concentrates used to prepare such beverages, the level of organic acids can range from 0.15 to 5% by weight. For preferred beverages having from 0.055 to 0.09% by weight solubilized calcium, the level of organic acids preferably ranges from 0.1 to 0.6% by weight. For beverage concentrates used to prepare these preferred beverages, the level of organic acids preferably ranges from 0.3 to 3% by weight. The level of other acids (e.g. phosphoric acid) can comprise from 0 to 70% by weight of the acid component, and preferably comprises from 0 to 50% by weight of the acid component.

For the purposes of the present invention, the level of the acid component (hereafter total acids) depends on the beverage composition involved, the level of calcium included, as well as the mouthfeel and stability properties desired. For beverages having from 0.05 to 0.15% by weight solubilized calcium, the level of total acids can range from 0.15 to 1% by weight. For beverage concentrates used to prepare such beverages, the level of total acids can range from 0.45 to 5% by weight. For preferred beverages having from 0.055 to 0.09% by weight solubilized calcium, the level of total acids preferably ranges from 0.2 to 0.6% by weight. For beverage concentrates used to prepare these preferred beverages, the level of total acids preferably ranges from 0.6 to 3% by weight.

There are two other important factors with regard to the beverages and beverage concentrates of the present invention. One is the weight ratio of total acids and chloride combined to calcium. For the purposes of the present invention, this weight ratio can range from 4 to 7. At weight ratios much below 4, it becomes much more difficult to stabilize the beverage and beverage concentrates against precipitation of insoluble calcium salts. At

weight ratios much above 7, the beverage becomes too sour from a taste standpoint. Preferred beverages and beverage concentrates of the present invention have a weight ratio of total acids and chloride combined to calcium of from 4.4 to 6.5.

The other important factor for beverages and beverage concentrates of the present invention is the level of chloride present. Inclusion of low levels of chloride in beverages and beverage concentrates of the present invention has been found to have two particularly important effects. The first is to cause a quicker onset of sourness in the beverage. This is believed to be due to a reduction in the pH of the beverage as the result of reducing the buffering capacity of the edible acids present. The other important effect is improving the solubility of calcium in the beverage/concentrate, even when high levels of citric or phosphoric acid are used. This is also believed to be due to a reduction in the pH/buffering capacity of the acids present.

For beverages having from 0.05 to 0.15% by weight solubilized calcium, the level of chloride can range from 0.02 to 0.05% by weight. (For beverage concentrates used to prepare such beverages, the level of chloride can range from 0.06 to 0.25% by weight.) At chloride levels much above 0.05% by weight, the chloride concentration is sufficiently high to cause a noticeable salty/brackish note which is considered undesirable. At levels much below 0.02% by weight, the effect of chloride on sourness onset and improved solubility of calcium is significantly minimized. Preferably, the level of chloride is from 0.02 to 0.04% by weight for beverages of the present invention, and from 0.06 to 0.2% by weight for beverage concentrates used to prepare such beverages.

Sources of chloride for beverages and beverage concentrates of the present invention include hydrochloric acid or calcium chloride. Preferably, the chloride is derived from calcium chloride, which also serves as at least a partial source of calcium. Typically, calcium chloride supplies from 7.5 to 56% by weight of the solubilized calcium in these beverages and beverage concentrates. Preferably, calcium chloride supplies from 12.5 to

41% of the calcium present in these beverages and beverage concentrates.

C. Flavor Component

The flavor component of the beverages and beverage concentrates of the present invention contains a flavor selected from fruit flavors, botanical flavors and mixtures thereof. As used herein, the term "fruit flavor" refers to those flavors derived from the edible reproductive part of a seed plant, especially one having a sweet pulp associated with the seed. Also included within the term "fruit flavor" are synthetically prepared flavors made to simulate fruit flavors derived from natural sources. Particularly preferred fruit flavors are the citrus flavors including orange flavors, lemon flavors, lime flavors and grapefruit flavors. Besides citrus flavors, a variety of other fruit flavors can be used such as apple flavors, grape flavors, cherry flavors, pineapple flavors and the like. These fruit flavors can be derived from natural sources such as fruit juices and flavor oils, or else synthetically prepared.

As used herein, the term "botanical flavor" refers to flavors derived from parts of a plant other than the fruit. As such, botanical flavors can include those flavors derived from nuts, bark, roots and leaves. Also included within the term "botanical flavor" are synthetically prepared flavors made to simulate botanical flavors derived from natural sources. Examples of such flavors include kola flavors, tea flavors, and the like. These botanical flavors can be derived from natural sources such as essential oils and extracts, or else can be synthetically prepared.

The flavor component can comprise a blend of various flavors, e.g. lemon and lime flavors, kola flavors with citrus flavors to form cola flavors, etc. If desired, fruit juices such as orange juice, lemon juice, lime juice, apple juice, grape juice and the like can be used in the flavor component. The flavors in the flavor component are sometimes formed into emulsion droplets which are then dispersed in the beverage concentrate. Because these droplets usually have a specific gravity less than that of water

and would therefore form a separate phase, weighting agents (which can also act as clouding agents) are typically used to keep the emulsion droplets dispersed in the beverage. Examples of such weighting agents are brominated vegetable oils (BVO) and rosin esters, in particular the ester gums. See L. F. Green, Developments in Soft Drinks Technology, Vol. 1, (Applied Science Publishers Ltd. 1978), pp. 87-93 (herein incorporated by reference), for a further description of the use of weighting and clouding agents in liquid beverages. Besides weighting agents, emulsifiers and emulsion stabilizers can be used to stabilize the emulsion droplets. Examples of such emulsifiers and emulsion stabilizers include the gums, pectins, celluloses, polysorbates, sorbitan esters and propylene glycol alginates. See L. F. Green, supra at p. 92.

The particular amount of the flavor component effective for imparting flavor characteristics to the beverages and beverage concentrates of the present invention ("flavor enhancing") can depend upon the flavor(s) selected, the flavor impression desired, and the form of the flavor component. For flavor components which are substantially free of fruit juice, i.e., on a single-strength basis, no more than 1% fruit juice by weight of the beverage, the flavor component can comprise at least 0.05% by weight of the beverage composition, and typically from 0.1 to 2% by weight for carbonated beverages. When fruit juices are used, the flavor component can comprise, on a single-strength basis, up to 20% fruit juice by weight of the beverage, preferably from 5 to 15% fruit juice by weight for carbonated beverages.

D. Sweeteners

Beverages and beverage syrups of the present invention contain a sweetener. The sweetener typically used is sugar. As used herein, the term "sugar" refers to mono- and di-saccharide sweeteners. Examples of such sugars include sucrose, glucose, fructose, high fructose corn syrup, invert sugar and the like. Preferred sugars are sucrose and high fructose corn syrup. Sugars, especially high fructose corn syrup, have been found to

enhance the absorbability/ bioavailability of calcium from beverages of the present invention.

For diet beverages, noncaloric sweeteners can be used. Examples of such sweeteners include saccharin, cyclamates, acetosulfam, L-aspartyl-L-phenylalanine lower alkyl ester sweeteners, L-aspartyl-D-alanine amides disclosed in U.S. Patent 4,411,925 to Brennan et al., issued October 23, 1983 (herein incorporated by reference), L-aspartyl-D-serine amides disclosed in U.S. Patent 4,399,163 to Brennan et al., issued August 16, 1983 (herein incorporated by reference), L-aspartyl-L-1-hydroxymethylalkaneamide sweeteners disclosed in U.S. Patent 4,338,346 to Brand, issued December 21, 1982 (herein incorporated by reference), L-aspartyl-1-hydroxyethylalkaneamide sweeteners disclosed in U.S. Patent 4,423,029 to Rizzi, issued December 27, 1983 (herein incorporated by reference), and the like. The acid systems of the present invention can be formulated to provide improved hydrolytic stability for beverages containing L-aspartyl-L-phenylalanine ester (e.g. aspartame) sweeteners in the critical pH range of from 4.0 to 4.8.

The amount of the sweetener effective in the beverages of the present invention depends upon the particular sweetener(s) used and the sweetness intensity desired. For noncaloric sweeteners, this amount varies depending upon the sweetness intensity of the particular sweetener. For sugar, this amount can be from 1 to 14% (typically from 6 to 14%) by weight for carbonated beverages. Preferred beverages contain from 9 to 13% by weight sugar. (In determining the amount of sugar for beverages of the present invention, any sugar or other sweetener present in the flavor component, such as in fruit juice, is also included.) Low-calorie sweetener combinations containing a noncaloric sweetener such as aspartame and a sugar such as high fructose corn syrup can also be used in beverages of the present invention. For beverage syrups of the present invention, the amount of sugar is significantly higher. Usually, the amount of sugar in a beverage

syrup is from 30 to 70% by weight. Preferably, such beverage syrups contain from 40 to 60% by weight sugar.

The beverages, beverage concentrates and beverage syrups of the present invention are typically substantially free of a sugar alcohol, i.e. less than 1% by weight. The sugar alcohols include sorbitol, mannitol and xylitol. Sugar alcohols are sometimes used as sweeteners for food products. However, these sugar alcohols, which are noncaloric, are also metabolized by lower gut flora, causing flatulence and related gastrointestinal (GI) tract problems such as diarrhea. Accordingly, at the levels required to sweeten beverages, sugar alcohols are not particularly useful in the present invention.

E. pH and Other Beverage Ingredients

The pH of the beverages and beverage concentrates of the present invention is dependent upon the particular composition of the acid component, the total amount of acids used and the sourness impression desired. Typically, the pH can range from 2.5 to 5.0. Preferred carbonated beverages have a pH of from 3.0 to 4.5.

Other minor beverage ingredients are frequently included in beverages and concentrates. Such ingredients include preservatives such as benzoic acid and salts thereof, sulfur dioxide, etc. Also, typically included are colors derived either from natural sources or synthetically prepared. See L. F. Green, Developments in Soft Drinks Technology, Vol. 1 (Applied Science Publishers Ltd. 1978), pp. 185-186 (herein incorporated by reference) for preservatives and colors used in beverages.

F. Beverage Preparation

The beverages and concentrates of the present invention can be prepared by standard beverage formulation techniques. Although noncarbonated beverages are within the scope of the present invention, particular emphasis is given to the making of carbonated beverages. It should be understood, however, that carbonated beverage making techniques, when appropriately modified, are also applicable to noncarbonated beverages. Also,

while the following description is with reference to sugar containing beverages, diet beverages containing noncaloric sweeteners can also be prepared by appropriate modification.

In making a sugar sweetened carbonated beverage, a beverage concentrate is usually formed. This beverage concentrate typically contains the emulsified or water-soluble flavors, emulsion stabilizing agents, and weighting agents if needed, any color desired and suitable preservatives. After the concentrate is formed, sugar and water are then added to make a beverage syrup. This beverage syrup is then mixed with an appropriate quantity of water to form the finished beverage. The weight ratio of water: syrup is from about 2:1 (3X syrup) to about 4:1 (5X syrup). Carbon dioxide can be introduced either into the water mixed with the beverage syrup or into the drinkable beverage to achieve carbonation. The carbonated beverage can then be placed in a container such as a bottle or can and then sealed. See L. F. Green, Developments in Soft Drinks Technology, Vol. 1, (Applied Science Publishers Ltd. 1978), pp. 102-107 (herein incorporated by reference), for a further description of beverage making, in particular the process for carbonation.

The amount of carbon dioxide introduced into the beverage can depend upon the particular flavor system used and the amount of carbonation desired. Usually, carbonated beverages of the present invention contain from 1.0 to 4.5 volumes of carbon dioxide. Preferred carbonated beverages contain from 2 to 3.5 volumes of carbon dioxide.

The calcium source(s) (e.g. calcium carbonate and calcium chloride) and the acids (e.g., citric, malic, and phosphoric) can be added at various points in this beverage concentrate-beverage syrup-carbonated beverage making process. The calcium source and acids are preferably added at the same point in this process, but can also be added at different points. Usually, the calcium source and acids are included during preparation of the beverage concentrate or during preparation of the beverage syrup.

Specific Embodiments of Beverages, Beverage Concentrates and Methods for Making Same According to the Present Invention

The following are specific embodiments of beverages, beverage syrups and methods for making same in accordance with the present invention:

Embodiment 1

A cola beverage was prepared from the following ingredients:

Ingredient	Amount (g.)
Aspartame	93.7
Calcium Carbonate	298.1
Calcium Chloride Dihydrate	142.0
Ascorbic Acid	56.8
75% Phosphoric Acid	303.8
Citric Acid (Anhydrous)	283.9
Sodium Benzoate	142.0
Caffeine	5.68
Flavor	760.9
Apple Juice Concentrate	4627.7
Color	397.5

The cola beverage was prepared as follows:

About 60 gallons of water was added to a mixing tank. The caffeine and citric acid were predissolved in some water and then added to the tank. Phosphoric acid and aspartame were added to the tank and mixed until dissolved. Calcium carbonate and calcium chloride were added to the tank and mixed until dissolved. Apple juice concentrate, sodium benzoate (predissolved in some water), color, and flavor were added to the tank and mixed. Water was added to make the final volume 75 gallons. This product was carbonated to 3.8 volumes CO_2, added to 16 ounce bottles, and capped. The product had a pH of 4.42.

Embodiment 2

The following ingredients were mixed together to provide a lemon/lime beverage:

Ingredient	Amount (%)
Water	84.98
Citric Acid (Anhydrous)	0.31
Sodium Benzoate	0.05
Calcium Carbonate	0.105
Calcium Chloride Dihydrate	0.051
High Fructose Corn Syrup 55	14
Lemon/Lime Flavor	0.5

A 1500 g. batch of the lemon/lime beverage was prepared. The product was added to three 16 oz. bottles (about 480 g./bottle) and then carbonated to about 3.5 volumes CO_2. The product had a pH of 3.9.

Embodiment 3

A lemon/lime beverage syrup was prepared from the following ingredients:

Ingredient	Amount (g.)
Grape Juice Concentrate (68°Brix)	1500
Citric Acid (Anhydrous)	138
Malic Acid	24
Calcium Chloride Dihydrate	30
Calcium Carbonate	63
High Fructose Corn Syrup 80	6120
Ascorbic Acid	12
Flavor	252
Potassium Benzoate	30
Water	8028
Total	16197

The ingredients were mixed together in 6438 g. of the water. After mixing, the remaining 1590 g. of water was then added to provide the beverage syrup.

This beverage syrup was added to 16 oz. bottles at 127.7 g./bottle. Carbonated water (5.2 volumes CO_2) was then added to each bottle to make 16 oz (volume basis) of finished beverage having a pH of 3.93.

Embodiment 4

A lemon/lime beverage was prepared by mixing together the following ingredients:

Ingredient	Amount (g.)
Citric Acid (Anhydrous)	1.55
Fumaric Acid	1.55
Calcium Chloride Dihydrate	0.51
Calcium Hydroxide	0.78
High Fructose Corn Syrup 55	140
Flavor	5
Sodium Benzoate	0.5
Water	850.11
Total	1000

For Embodiments 1 to 4, the level of calcium (Ca), total acids (TA), organic acids (OA) and chloride (Cl), and the total acids plus chloride to calcium weight ratio (TA + Cl/CA) are shown in the following table:

Embod.	Ca (%)	TA (%)	OA (%)	Cl (%)	TA + Cl/Ca
1	0.055	0.217	0.137*	0.024	4.4
2	0.056	0.31	0.31	0.025	6.0
3	0.054	0.296	0.296*	0.023	5.9
4	0.056	0.31	0.31	0.025	6.0

*Includes organic acids from juice

WHAT IS CLAIMED IS:

1. A calcium-supplemented beverage, which comprises:
   (a) from 0.05 to 0.15% by weight solubilized calcium;
   (b) from 0.15 to 1% by weight of an edible acid component comprising from about 0.05 to about 1% by weight of an edible organic acid selected from the group consisting of citric acid, malic acid, fumaric acid, adipic acid, gluconic acid, tartaric acid, lactic acid and mixtures thereof;
   (c) from 0.02 to 0.05% by weight chloride;
   (d) the weight ratio of said acid component and said chloride combined to said solubilized calcium being from 4 to 7;
   (e) a flavor component which contains a flavor selected from the group consisting of fruit flavors, botanical flavors and mixtures thereof in an amount effective to impart flavor characteristics to the beverage and which contains no more than 20% fruit juice by weight on a single-strength basis; and
   (f) an effective amount of a sweetener.

2. The beverage of Claim 1 which comprises from 0.055 to 0.09% by weight of said solubilized calcium, from 0.2 to 0.6% by weight of said acid component and from 0.1 to 0.6% by weight of said organic acid.

3. The beverage of Claim 2 wherein said organic comprises citric acid, malic acid or mixtures thereof.

4. The beverage of Claim 1 wherein said acid component further comprises from 0 to about 70% by weight of said acid component of an inorganic acid.

5. The beverage of Claim 4 wherein said inorganic acid is phosphoric acid.

6. The beverage of Claim 1 wherein the level of said chloride is from 0.02 to 0.04% by weight and wherein said weight ratio is from 4.4 to 6.5.

7. The beverage of Claim 1 wherein said sweetener comprises from 6 to 14% by weight sugar.

8. The beverage of Claim 7 wherein said sugar is high fructose corn syrup.

9. The beverage of Claim 1 wherein said sweetener comprises a noncaloric sweetener.

10. The beverage of Claim 9 wherein said noncaloric sweetener comprises aspartame.

11. The beverage of Claim 1 which is carbonated with from 1.0 to 4.5 volumes of carbon dioxide.

12. The carbonated beverage of Claim 11 which contains from 2 to 3.5 volumes of carbon dioxide.

13. The carbonated beverage of Claim 12 wherein said flavor component comprises from 5 to 15% fruit juice by weight of the beverage.

14. The carbonated beverage of Claim 12 wherein said flavor component is substantially free of fruit juice.

15. A beverage concentrate in liquid form for preparing a drinkable beverage, which comprises:

(a) from 0.15 to 0.75% by weight solubilized calcium;

(b) from 0.45 to 5% by weight of an edible acid component comprising from about 0.15 to about 5% by weight of an edible organic acid selected from the group consisting of

citric acid, malic acid, fumaric acid, adipic acid, gluconic acid, tartaric acid, lactic acid and mixtures thereof;

(c) from 0.06 to 0.25% by weight chloride;

(d) the weight ratio of said acid component and said chloride combined to said solubilized calcium being from 4 to 7; and

(e) a flavor component which contains a flavor selected from the group consisting of fruit flavors, botanical flavors and mixtures thereof in an amount effective to impart flavor characteristics to the beverage and which contains no more than 20% fruit juice by weight on a single-strength basis.

16. The concentrate of Claim 15 wherein the level of said chloride is from 0.06 to 0.2% by weight and wherein said weight ratio is from 4.4 to 6.5.

17. The concentrate of Claim 15 wherein said acid component further comprises from 0 to 70% by weight of said acid component of an inorganic acid.

18. The concentrate of Claim 17 wherein said inorganic acid is phosphoric acid.

19. The concentrate of Claim 15 which comprises from 0.16 to 0.45% by weight of said solubilized calcium, from 0.6 to 3% by weight of said acid component and from 0.3 to 3% by weight of said organic acid.

20. The concentrate of Claim 18 wherein said organic acid comprises citric acid, malic acid or mixtures thereof.

21. The concentrate of Claim 15 which comprises from 30 to 70% by weight water.

22. The concentrate of Claim 21 which further comprises from 30 to 70% by weight sugar.

23. The concentrate of Claim 21 wherein said sugar is high fructose corn syrup.

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